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THE SPECTRA OF TEN STARS OF VERY LOW LUMINOSITY.

The spectral classification of the following ten stars is of interest because they are among the very faintest stars intrinsically that are known:—

	Mag	R.A. 1910		Dec.	μ	π	($\frac{Sun}{= 1}$) Lum.	($\frac{Sun}{= 5.5}$) Abs. Mag	Spec.
		h	m	°	"	"			
Comp. to α <i>Eridani</i> .	9.1	4	11.2	—7 48	4.08	+0.174	0.012	10.3	Ao
Lal. 21185	7.6	10	58.4	+36 35	4.77	0.403	0.009	10.6	Ma
Lal. 21258	8.9	11	1.1	+43 59	4.46	0.203	0.011	10.4	Ma
A Oe 17415-6	9.3	17	37.0	+68 26	1.31	0.268	0.004	11.4	Mb
Comp. to μ <i>Herculis</i>	11.0	17	42.9	+27 46	0.31	0.106	0.006	11.1	Ma
Pos. Med. 2164 . . .	9.3	18	41.9	+59 30	2.28	0.292	0.003	11.6	Ma
Comp. to γ <i>Lyræ</i> . .	12.0	19	4.0	+32 21	1.66	0.15	0.001	12.9	Ma
Lal. 40844	9.0	21	0.9	+6 43	0.57	0.167	0.014	10.1	K6
Kruger 60	9.2	22	24.8	+57 15	0.92	0.256	0.005	11.2	Mb
Lal. 46650	8.9	23	44.5	+1 55	1.40	0.183	0.013	10.2	Ma

No less than eight of the ten stars are of type M, while one of the remaining two is of the advanced type K6. The A star, companion to α *Eridani*, has been referred to in a previous note in this publication. The great preponderance of the M type of spectrum is of especial importance in its bearing on the colors of faint stars.

It is of interest to note that in all of these stars, except the Ao star, the calcium lines at λ 4435 and λ 4455 are very prominent. We have found previously that these lines appear to serve as an excellent criterion of absolute magnitude.

W. S. ADAMS and F. G. PEASE.

COLOR INDICES IN THE SYSTEM OF TW ANDROMEDÆ.

For the purpose of determining simultaneously the photographic and photovisual light curves of the eclipsing binary TW *Andromedæ*, and in particular to ascertain the relative color of the faint companion, a series of observations has been undertaken with the 60-inch reflector. Sixty-five plates, representing a total of nearly 300 exposures, have been secured up to the present, and since considerable time must elapse before the observations can be completed and the plates measured and discussed, provisional results will be reported in the present note.

It was known from photometric observations made at Brussels and elsewhere that at deepest phase of the principal minimum of TW *Andromedæ* the light remained constant for two hours or more. From the total duration of the minimum and the range of variation it is easy to show that the principal eclipse must be total; that is, the bright star is then completely obscured by a relatively large and faint companion. Obviously, then, the photographic and photovisual magnitudes at that time give the color of the faint companion, and, neglecting possible effects of absorption in space, give also an indication of its spectrum.

Observations have been made at three epochs of principal minimum, and at two the constant minimum phase was observed. Exposures were made alternately on Seed 27 plates and on Cramer isochromatic plates used in connection with a yellow filter. The magnitudes of the companion stars were determined by means of diaphragm plates and the zero points fixed by exposing alternately on stars of the North Polar Sequence and on the field of the variable. Judging from the color indices, the comparison stars are of spectral types A and F. The results given below must be considered provisional, but it is not likely that these values will be changed greatly with the completion of the study of the light curve.

The magnitudes for the variable are as follows:

	Photographic	Photovisual
Magnitude at maximum	9.74	9.09
Magnitude at minimum	11.78	10.72
Range	2.04	1.63
Light of brighter component	85%	78%
Magnitude of brighter component	9.92	9.36

The color index of the faint component is the difference between the photographic and photovisual magnitudes at minimum. The magnitude at maximum, however, represents the combined light of both components. To get the light of the brighter component alone, we subtract 15 per cent of the total from the photographic light at maximum and 22 per cent from the photovisual, with the results given above.

The color index of the bright star is $+0.56$, corresponding to a spectrum of type F3, and that of its large faint companion,

+ 1.06, corresponding to G4. It will be possible to check the relation between color index and spectral type in this instance by a direct classification of both spectra.

A preliminary solution for some of the orbital elements of the system permits a rough determination of the density of the two stars. It is found that for the faint component the density in terms of the Sun will not exceed a few hundredths and may be much less; for the brighter component the density will probably not be less than four tenths that of the Sun, a value in good agreement with the known density of several F-type eclipsing stars.

The change in color at a total eclipse has been determined definitely heretofore in the case of only one star, namely for RR *Draconis*, by SEARES, using the 60-inch reflector. In that case a similar result was obtained; the photographic range was found to be 3^m.82, while the photovisual range was 0^m.57 less. In the system of RR *Draconis*, as in TW *Andromedæ*, the fainter, redder companion is probably much less dense than its bluer primary. It has in both systems many times the volume of the brighter component and probably has smaller mass. We may expect, then, that the atmospheric conditions are not the same and that, as a consequence, the difference in color indices between the two components may possibly be due in part to peculiar atmospheric absorption rather than to conspicuous difference in spectral type.

HARLOW SHAPLEY.

MOUNT WILSON SOLAR OBSERVATORY,
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THREE STARS WITH BRIGHT HYDROGEN LINES.

The following stars have one or more bright hydrogen lines in their spectra:—

Boss 1215	6.0	B6	5 ^h 2 ^m .5	+21° 35'	H β and H γ
BD — 8° 4352	8.8	Ma	16 50 .7	— 8 10	H β , H γ , etc.
BD +13° 4692	6.6	B6	21 19 .5	+13 40	H β

The most interesting of these stars is the second. It has a proper motion of 1".29 annually, and a measured parallax of 0".210. Its absolute magnitude, therefore, (*Sun* = 5.5) is